APPLICATION FOR

UNITED STATES PATTENT

SPECIFICATIONS

TO ALL WHOM IT MAY CONCERN

Be it known that I, Miguel A. Timm, a citizen of the United States of America and resident of the State of Texas, having a postal address of 17319 Cypress Spring Drive, City of Spring, County of Harris, State of Texas, have invented a new and useful "SELF-CONTAINED ELECTRONIC PRESSURE MONITORING AND SHUTDOWN DEVICE" of which the following forms the specifications.

"SELF-CONTAINED ELECTRONIC PRESSURE MONITORING AND SHUTDOWN DEVICE"

CROSS REFFERENCE TO RELATED APPLICATIONS Not applicable

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT Not applicable

BACKGROUND OF THE INVENTION

The present invention relates to the field of industrial safety to shutdown a process or flow when the fluid reaches an unsafe pressure. In the event of detecting an alarm condition the invented device will provide a pneumatic or hydraulic signal to cause a safety shutdown.

DESCRIPTION OF RELATED ART

As shown in the reference U.S. Patents Numbers 6,276,135; 5,213,133; 4,616,670 and 4,485,727 the prior art has an abundance of diverse process shutdown systems.

While the prior art inventions are adequate for the basic purpose and function for which they have been designed, they fail to provide a simple, reliable and ergonomic device that monitors the process' pressure and initiates shutdown when the sensed pressure falls out of the preset limits. A number of the prior art devices have sliding seals that are prone to become frozen after some time because of lubricants

drying out, creating the need for frequent preventive maintenance by highly specialized instrumentation personnel. Another type of device seen on the prior art resorts to bourdon tubes that directly control pneumatic valves which leads to very delicate mechanisms, expensive and prone to failures.

Adding to the above disadvantages, some of the devices shown on the prior art have just one alarm point, creating the need of two separate devices to protect against high and low pressure conditions. Furthermore, the operators have little means to know the mechanical conditions of the shutdown device, as they do not show any activity until an abnormal pressure is detected.

As consequence of the above there is a need for a better mean to sense pressure and provide a simple and reliable safety shutdown device for unattended installations to protect them when the pressure reaches unsafe limits.

BRIEF SUMMARY OF THE INVENTION

The Self-Contained Electronic Pressure Monitoring and Shutdown Device provides the means for a safety process shutdown that is reliable, needs minimal maintenance and provides the operator with direct reading of the process' pressure as well as the high and low pressure settings. Also, it provides a flashing lamp for each specific cause of shutdown and the means to recall the last cause of shutdown after the device has been reset. The invention is constituted of a Switch-Gauge (1) (a pressure gauge with electric contacts for high and low pressure alarms), an Electronic Logic Circuit (2), a Power Module (3), a Pulse Driven Solenoid Valve (4), a "High Pressure" indicator lamp (5), a "Low Pressure" indicator lamp (6), a "Low Battery" indicator lamp (7), a "System OK" indicator lamp (8) a "Reset" momentary switch or pushbutton (9) and a "Test" momentary switch or pushbutton (10). In essence the system uses the Switch-Gauge (1) to sense the high and low pressure conditions and when an abnormal pressure is detected the Electronic Logic Circuit (2) sends one or more consecutive "shutdown" pulses to the Pulse Driven Solenoid Valve (4) which controls a pneumatic or hydraulic signal that initiates the shutdown.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

Fig. 1 is a schematic illustrating the general arrangement of the Self-Contained Pressure Monitoring and Shutdown Device.

Fig. 2 is a schematic illustrating the interconnection of the battery cells of the Power Module (3).

Fig. 3 is a schematic illustrating a battery-less alternative for the Power Module (3-A).

DETAILED DESCRIPTION OF THE INVENTION

The device is composed of a Switch-Gauge (1), Electronic Logic Circuit (2), Power Module (3), High Pressure indicating lamp (5), Low Pressure indicating lamp (6), Low Battery indicating lamp (7), System OK indicating lamp (8), a momentary switch or pushbutton "Reset" (9) and a momentary switch or pushbutton "Test" (10).

When operating under normal conditions, the contacts in the Switch-Gauge (1) remain on their normally open condition and the Electronic Logic Circuit (2) remains in a routine of continuously scanning the input signals and periodically reading power voltages. The sign of life in the system is that the "System OK" lamp flashes every one or two seconds to show the operator that the system is working and no abnormal conditions have been detected.

If one of the contacts in the Switch-Gauge (1) goes from its normally open to a close condition (alarm), the Electronic Logic Circuit (2) confirms the alarm by re-scanning and re-confirming it for about one second before taking action. Once the alarm is confirmed, the Electronic Logic Circuit (2) generates one or more consecutive shutdown pulses to trip the Pulse Driven Solenoid Valve (4), causing the shutdown of the process. The subsequent shutdown pulses are for redundancy to insure that action is taken.

It is to be noted that the Electronic Logic Circuit (2) can be jumper-configured by the operator in the field to have a pre-programmed time delay (i.e. 15 seconds) before responding to a high or a low pressure condition. The time delay can be configured independently for the high or the low-pressure alarm and it allows the system to ignore temporary pressure excursions, as those excursions may be normal in some processes.

If a shutdown would occur the Electronic Logic Circuit (2) flashes de corresponding alarm indicator lamp to display the specific cause of it. The alarm indicator lamp will continue to flash even if the Switch-Gauge (1) contact goes back to normal or other alarm is sensed in order to insure that the cause of the shutdown is made known to the operator when he arrives to the location. The device will continue to display the condition causing the shutdown until the operator presses the "Reset" momentary switch or pushbutton (9).

When the "Reset" switch or pushbutton (9) is pressed the alarm lamp turns "off" and the Electronic Logic Circuit (2) pulses the Pulse Driven Solenoid Valve (4) back to "Open" to allow the process to resume. Also, after the device is "Reset" by the operator the Electronic Logic Circuit (2) will ignore any alarm that may be present for a pre-programmed period of time (i.e. 30 minutes) to allow the process to return to normal. If the alarm continues to be present after that period of time the Electronic Logic Circuit (2) will initiate shutdown again.

If the device detects that one of the battery voltages is reaching below a pre-programmed level, it will blink the Low Battery Voltage lamp (7) instead of the System OK lamp (8) to alert the operator that it is time to replace the batteries. If the batteries are not replaced within reasonable time the voltage will eventually fall below a pre-programmed "low-low" level the Electronic Logic Circuit (2) will initiate shutdown as the low voltage will compromise the device's reliability.

The Power Module (3), as shown in Fig. 2 is constituted of a number of battery cells, such as lithium batteries and provides two voltages, a low voltage (i.e. 2.2 to 5.5 VDC) for feeding the Electronic Logic Circuit (2) and a separate high voltage (i.e. 6 to

30 VDC) to feed the driver circuits of the Pulse Driven Solenoid Valve (4). Separating the power to the Pulse Driven Solenoid Valve (4) from the power for the Electronic Logic Circuit (2) insures that the Electronic Logic Circuit (2) will not be at all affected by the transients caused by the driving of the Pulse Driven Solenoid Valve (4). It is to be noted that the pulse driven solenoid valves take considerable amount of power while being pulsed and a capacitor of 1,000 uF or bigger may be needed to assist the power module to provide the high current needed to trip the Pulse Driven Solenoid Valve (4).

Given the low power consumption achievable with the current electronic circuits combined with the fact that the pulse driven solenoid valve consumes no power except when being tripped, the power module can be designed to last five (5) or more years before battery replacement is needed.

An alternative Power Module (3-A) using no batteries is shown on Fig. 3. In this alternative option the Power Module (3-A) is constituted of a photovoltaic module and three large capacitors (C1, C2 and C3) to store the energy needed to keep the circuits operating throughout the night. In essence the capacitors are used as rechargeable batteries, recharged on a daily basis by the photovoltaic module (SM1). Given the low power used by the system a small solar module will be capable of recharging the capacitors even in cloudy days. The alternative Power Module (3-A) is better suited if the system is to be located in a region where replacement batteries are difficult to obtain or the ambient temperatures are so extreme that using batteries is not advisable.

As shown in Fig. 3, the high voltage capacitor (C1) is charged directly from the solar module (SM1) and it will remain charged throughout the night as the blocking diode (D1) prevents the current from flowing back. The charge stored on the high voltage capacitor (C1) is for driving the pulse driven solenoid valve (4) and there is virtually no discharging unless power is consumed to drive the solenoid valve (4) in the event of a shutdown.

In contrast, the electronic logic module is continuously consuming some current from the low voltage source (roughly 50 uA in current version) and it runs mainly on